

Space PV Concentrators for Outer Planet and Near-Sun Missions, Using Ultra-Light Fresnel Lenses Made with Vanishing Tools, Phase I

Completed Technology Project (2018 - 2019)



Project Introduction

Identification and Significance of the Innovation

Under recent NASA SBIR, STTR, and other programs, our team has developed both line-focus and point-focus Fresnel lens PV concentrators with unprecedented performance and cost metrics. This new Phase I proposal addresses a remaining mass-production issue for the ultra-light lenses used in both line-focus and point-focus embodiments of the space PV concentrator technology. After casting the silicone lens, removing the lens tool is difficult, time-consuming, and often damaging to the lens. A vanishing lens tool would completely solve this problem, making high-quality, mass-producible, low-cost, ultra-light Fresnel lenses available for future space PV concentrators. These concentrators offer unrivaled benefits for outer planet and near-sun missions, especially in rad-hardness, LILT-tolerance, and HIHT-tolerance.

Technical Objectives, Work Plan, and Deliverables

Technical Objectives: To (1) Select Candidate Vanishing Lens Tool Materials, (2) Procure Electroform Replicas of 25X Point-Focus Lens Pattern, (3) Produce Vanishing Lens Prototype Tools, (4) Produce and Inspect Lenses (Glass Superstrate and Mesh), (5) Outdoor-Test Best Lenses for Optical Efficiency, (6) Select Best Vanishing Lens Tool Material, (7) Produce 10 Prototype Vanishing Lens Tools, (8) Produce and Outdoor-Test 10 Lenses, (9) Explore Mass Production of Vanishing Lens Tools from Selected Material with Vendors, (10) Prepare Technology Development Roadmap for Phase II and Beyond, (11) Provide All Required Reports, Reviews, and Deliverables.

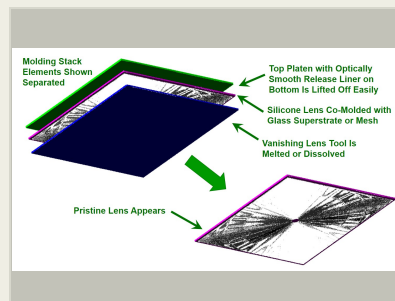
Work Plan: Over a 6-month performance period, we will perform 11 tasks linked directly to the 11 objectives.

Deliverables: 3 Program Reviews, 2 Program Reports, 10 Lenses (5 Glass Superstrate + 5 Embedded Mesh), and Phase II Proposal

Anticipated Benefits

The Unique Line-Focus and Point-Focus Space PV Concentrators Using Fresnel Lenses Made from the New Process Will Be Applicable to Numerous Missions, Especially to the Moon, Mars, Deep Space, and Inner Planets. The Unprecedented Cost and Performance Metrics and the Tolerance of Radiation, LILT, and HIHT Effects May Be Mission-Enabling for Many Planned Missions. NASA Is Currently Funding Development of this Technology for Extreme Environment Solar Power (**EESP**) Applications to Outer Planets.

The Unique Line-Focus and Point-Focus Space PV Concentrators Using Fresnel Lenses Made from the New Process Will Be Applicable to Numerous DOD and Commercial Space Missions, Especially **SEP** Missions, Asteroid Missions, etc., and Rad-Hard, Laser-Hard, Resilient National Security Spacecraft. We Are Already Working with Aerospace Firms and DOD on PV Concentrators for Their



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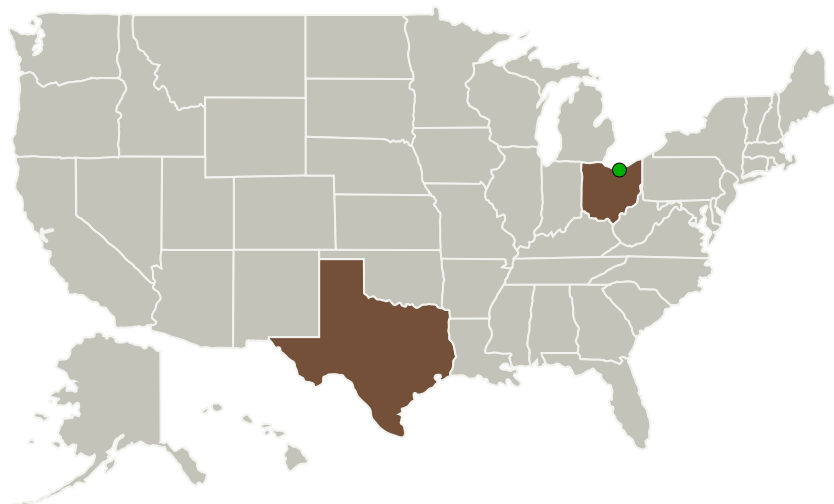
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Missions. DOD Has Long Funded Our PV Concentrators, from the **SCARLET** Array on Deep Space 1 to **SLATE** on TacSat 4.

Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|-------------------------------|-------------------------|-------------|-----------------|
| Mark O'Neill, LLC | Lead Organization | Industry | Keller, Texas |
| ● Glenn Research Center(GRC) | Supporting Organization | NASA Center | Cleveland, Ohio |

| Primary U.S. Work Locations | |
|-----------------------------|-------|
| Ohio | Texas |

Project Transitions

July 2018: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Mark O'Neill, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

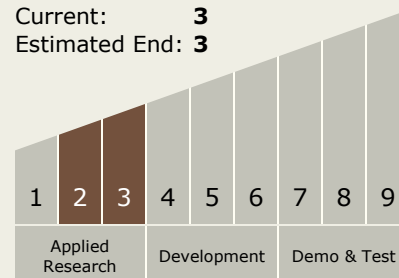
Carlos Torrez

Principal Investigator:

Mark O'Neill

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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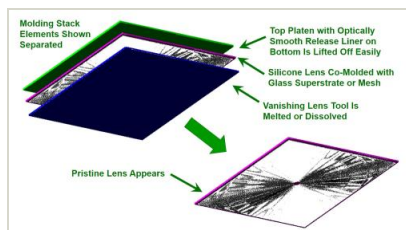


✓ **February 2019:** Closed out

Closeout Documentation:

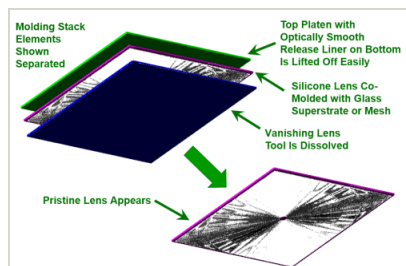
- Final Summary Chart(<https://techport.nasa.gov/file/137910>)

Images



Briefing Chart Image

Space PV Concentrators for Outer Planet and Near-Sun Missions, Using Ultra-Light Fresnel Lenses Made with Vanishing Tools, Phase I (<https://techport.nasa.gov/image/131711>)



Final Summary Chart Image

Space PV Concentrators for Outer Planet and Near-Sun Missions, Using Ultra-Light Fresnel Lenses Made with Vanishing Tools, Phase I (<https://techport.nasa.gov/image/130523>)

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
 - └ TX03.1 Power Generation and Energy Conversion
 - └ TX03.1.1 Photovoltaic

Target Destinations

The Sun, Others Inside the Solar System